Kiwifruit Manual

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Kiwifruit Manual

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By

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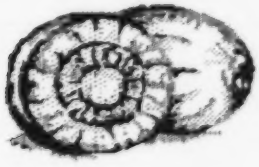

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Index

Acknowledgements iv
Introduction/ The Plant History in B.C. 1
Site Selection in B.C.: (soil, water and climate requirements) 3
Varieties - Selections: (seeds, cuttings or grafted vines) 5
Support Systems: (pergola vs. T-Bar) 5
Irrigation System Design 7
Planting 7
Pollination 8
Pruning 10
Fertilization 12
Weed Control 14
Insect and Disease Control 14
Winter Injury 15
Yields and Harvesting: (maturity testing) 16
Packaging 17
Storage 18
Greenhouse Kiwifruit Production 18
World Crop Outlook 19
Costs of Production 19
References 21

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And of course a final thank you goes to a man who had a dream of growing kiwifruit in British Columbia, Mr. Henri Bailly. Without his persistence, it is unlikely there would be a kiwifruit industry here today.

Introduction

The kiwifruit vine *Actinidia deliciosa* (A. Chev) is a dioecious plant only recently introduced to British Columbia as a commercial crop.

The vines have been cultivated in New Zealand for more than 70 years, but it is only in the past 20 years that production has increased dramatically due to the world-wide marketing and promotional efforts of various New Zealand growers associations. There have also been vines in California for more than 50 years, but commercial production didn't begin there until the 1960s.

Plantings have increased at a tremendous rate during the past five years, particularly in Europe and Chile. In Chile more than 15,000 acres of the crop were planted in that period.

Consumer demand has remained strong (North American consumption is up1,000 percent in the last five years), but as larger volumes of fruit have become available, worldwide prices have declined dramatically to the point where as much as 30 percent of the New Zealand industry is experiencing financial difficulty.

The B.C. kiwifruit industry has anxiously watched the fall of world prices, hoping that market availability and packaging innovation will provide the extra income required to make this a stable, long term crop for the area.

The History of Kiwifruit Production in British Columbia

The initial drive to establish kiwifruit production in B.C. can be attributed to a former British Columbia resident with a lifelong interest in horticulture, Mr. Henri Bailly.

In 1976, Mr. Bailly went to the Agriculture Canada Research Station at Sidney and met with the director, Dr. Harry Andison, to try to persuade him that kiwifruit would prosper in this area. The initial response to Mr. Bailly's suggestion was negative but he persisted, finally convincing Dr. Andison to establish some of his seedling selections. At the same time he established vines at the property of a friend, Mr. Art Garcia, in Metchosin. In 1979 Mr. Garcia's plants bore their first five fruit. The planting at the Agriculture Canada station, by then under the direction of Dr. Joe Molnar, began to bear fruit in 1982.

As this was occurring, potato growers in the Central Saanich area of the Saanich Peninsula were being told by Agriculture Canada that they could no longer grow potatoes due to the golden nematode quarantine. Agriculture Canada embarked on a program to find alternative crops for these growers. Many potentially viable crops were evaluated, but in the end no one crop could be substituted for the 500-plus acres taken out of potato production.

There was at this time a developing interest, albeit a small one, in the kiwifruit planting at Sidney. One of the affected potato growers, Mr. Ian Vantreight, decided he would like to establish the first commercial kiwifruit planting in Canada. With assistance from the New Crop Development Fund (NCDF) of Agriculture Canada and the British Columbia Ministry of Agriculture and Fisheries (BCMAF) a project was designed to assist three growers with establishment of one-acre kiwifruit plantings — two on Vancouver Island and one in the Fraser Valley. This project, managed by the BCMAF, provided approximately $7,000 in funding to each grower for the purchase of plants and material for trellis and irrigation systems. All other expenses and maintenance were to be provided by the farmers. As it turned out, the government assistance was inadequate to cover

even the material costs which on one planting, due to the need for tile drainage, were in excess of $15,000 per acre.

All the original kiwifruit vines were supplied by the Mike Tanimoto Nursery in California and were planted in the spring of 1985. In addition to the three one-acre government-assisted plantings, 13 acres of vines were planted by two of the three growers.

The weather in 1985 was extremely warm and the kiwifruit vines grew very well. However unusually cold temperatures in October of that year followed by a record cold spell in late November were disastrous for the young plants. The entire 10-acre Fraser Valley planting at Langley, which included a one-acre NCDF planting, was killed. Damage on the Island was not as severe, ranging from little or no damage to total plant kill in some plantings

When Dr. Molnar was in New Zealand in 1984, he persuaded a kiwifruit research scientist, Mr. Nick Pyke, to come to Canada for one year to continue his work on the cold hardiness of kiwifruit vines. Mr. Pyke's stay in Canada was financed by the New Zealand government, the B.C. Ministry of Agriculture and Fisheries and Agriculture Canada. Following Mr. Pyke's arrival in 1986, an Agriculture Regional Diversification Subsidy Agreement (ARDSA) project, jointly funded by Agriculture Canada and the BCMAF, was initiated to develop protection for the kiwifruit vines from sudden temperature extremes. In addition, climatological data were used to determine areas in B.C. where kiwifruit could be successfully grown.

Early in the spring of 1986, an international kiwifruit conference was organized at Sidney by the BCMAF and the newly-formed Kiwifruit Growers Association of British Columbia (KGABC). Kiwifruit experts from California, New Zealand, the Channel Islands and Ontario were brought to Sidney to provide B.C. growers with current research findings in kiwifruit production, both in the field and in greenhouses. More than 220 people from B.C., Washington and Oregon attended the meeting.

Mr. Pyke was at Sidney during the 1986 growing season and into early winter, working with climatologist Mr. Rod Chilton and staff from the BCMAF and Agriculture Canada. In December 1986 he returned to New Zealand, but during the summer of 1988 he spent an additional three months in B.C. finalizing the data from the project. The climatological study was completed by Mr. Chilton in 1987 and is available to potential growers.

During the summer of 1986, interest was also developing in the greenhouse culture of kiwifruit, due mainly to work done in Ontario and presented at the symposium by Dr. Neil Miles of the Horticulture Institute of Ontario (HRIO). To assist growers in dealing with the potential problems which could be encountered in this area, kiwifruit vines were planted in two of the plastic covered greenhouses at the Agriculture Canada Research Station at Sidney. Demonstration projects concerning disease control and pollination in greenhouse kiwifruit production were designed and implemented with funding provided by the BCMAF.

During 1987 work began on a number of projects concerning kiwifruit growing. Dr. Molnar had visited China in 1986 and obtained a number of kiwifruit seeds. Seeds from these fruit were germinated and planted out in 1987 for evaluation. Some of these seedlings were from fruit which may have potential for local production because of their cold hardiness or different fruit colour. The work under the ARDSA kiwifruit cold tolerance project was continued in Mr. Pyke's absence. Research into pollination difficulties was initiated during this year under a project funded by the BCMAF.

Since 1985 the BCMAF has been developing a set of standards for soil and tissue testing of kiwifruit orchards. More than 150 samples from growers' fields were submitted to the BCMAF Soils, Feed and Tissue Testing Laboratory in Kelowna at no charge to the growers. Not only did this assist growers with immediate problems, but by the spring of 1988, a series of guidelines was available to enable growers to monitor their plants' performance throughout the growing season.

The winter of 1986 was extremely mild and all 51 acres of kiwifruit plantings in B.C. grew well. In October of 1987 the first commercial crop of kiwifruit — approximately 22 tons — was harvested. The fruit was graded and packaged by Vantreight Farms, a member of the KGABC. The Agriculture Canada planting at Sidney also had its first large crop in 1987. Approximately 6,000 pounds of fruit were produced.

Projects on cold hardiness, pollination and climatological data collection are continuing. Projects initiated in 1988 included a demonstration of artificial pollination technology developed in New Zealand and the application of the technology to both greenhouse and field production.

Another international kiwifruit conference was held on Vancouver Island in 1988. Once again this conference brought state-of-the-art technology to local growers. Approximately 10 acres of new plantings were established in B.C. in 1988. A fruit packing, grading and storage facility for kiwifruit was constructed by Vantreight Farms, with assistance from ARDSA, in 1989.

In 1987 Agriculture Canada closed the research division of the Research Station at Sidney, leaving only the quarantine division in operation. However the kiwifruit planting remained, tended by a part-time labourer. Problems arose in November when part of the original Bailly planting was removed by Agriculture Canada against the wishes of the KGABC. This resulted in meetings between Agriculture Canada, the KGABC and BCMAF on the future of the entire planting. At that time it was decided that the subsequent work on the planting would be directed by a committee made up of representatives of the KGABC, Agriculture Canada and the BCMAF. All fruit not required for scientific research would become the property of the KGABC, which would in turn contribute the funds necessary to maintain the planting.

The 1988 crop year was a good one for local growers, with more than 250,000 pounds harvested for sale. Plantings are expected to increase gradually until 1995, coinciding with the development of the Vantreight packing facility.

Site Selection

Climate

Outdoor cultivation of kiwifruit vines, *Actinidia deliciosa*, is only possible in a very limited area in British Columbia due to climatic restrictions. Based on work done by Mr. Chilton, it has been determined that the majority of this area is on the southernmost tip of Vancouver Island. There is also an area in the Fraser Valley, centered around Abbotsford, where historical weather data suggests that kiwifruit culture may be possible with proper vine management. The limiting factor in most areas of the mainland is extreme winter minimum temperatures, rather than spring or fall frosts.

Mr. Chilton's publication on the climatological analysis of the Saanich Peninsula pinpoints the areas of the peninsula least likely to be seriously affected by a fall frost. The publication is available from the BCMAF office at Sidney.

Kiwifruit are generally harvested on the Saanich Peninsula during the latter part of October. The following two charts from Mr. Chilton's publication demonstrate why only the southernmost area of Vancouver Island can be considered a low risk area for kiwifruit. Table 1 demonstrates the extremely low potential for fall frost damage and Table 2 shows the extreme winter minimum temperatures in certain key areas of the south coast during the winter of '85.

Entire plant death of even fully dormant mature kiwifruit vines will occur at temperatures below -19C (based on experiences worldwide). Therefore, many areas at the east end of the Fraser Valley would have been frozen out, had they been planted in 1985. As it was, the entire 10-acre planting at Langley was killed to ground level by temperatures which dropped to -12C before the plants became fully dormant.

Other areas which have not been monitored, but may provide possible sites, include some of the southern Gulf Islands such as Saltspring, Galiano and Hornby. In most cases the limiting factor in these areas is the location of an adequate irrigation source.

Table 1

Long Term Federal Government Atmospheric Environment Service Stations - Autumn Freeze Risk In Percent (A-1 degree C temperature or lower occurring by these dates)

Station	October 15	October 25	November 4	November 9
Sidney (CDA)	0.0	1.6	14.1	18.8
Victoria Int'l. Airport	2.2	11.1	26.7	43.2
Comox Airport	11.6	30.2	48.8	62.8
Langley	3.7	18.5	40.7	51.9
Aldergrove	52.4	71.4	85.7	90.5
Abbotsford Airport	14.6	36.6	58.5	80.5
Chilliwack	0.0	0.0	9.4	21.9
Agassiz (CDA)	0.0	5.4	16.1	25.0

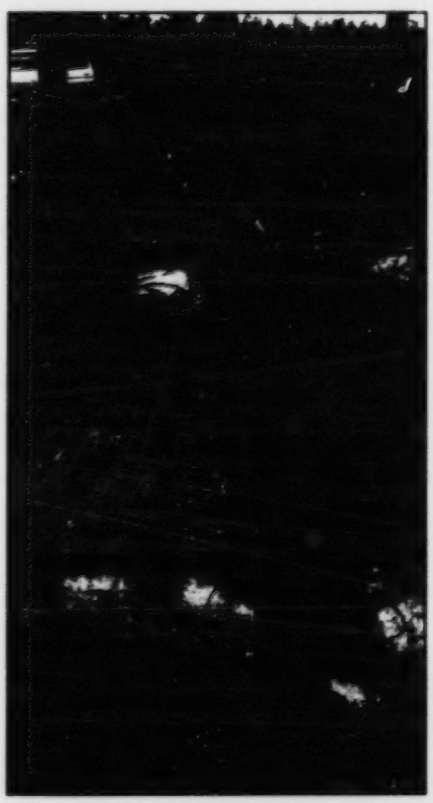
Table 2

Extreme 1985/86 Winter Minimum Temperature (degrees Celsius)

Sidney (CDA)	-10.5	Langley	-16.0
Victoria Airport	-12.7	Aldergrove	-15.5
Nanaimo	-15.4	Abbotsford	-16.7
Duncan Forestry	-17.0	Chilliwack	-19.0
Comox Airport	-13.3	Agassiz	-19.0
Hope	-21.4		

Soils

Kiwifruit vines require soil which is extremely well drained. In south coastal British Columbia, this is generally not a problem in the summer months, but can be a serious problem from November until May. Ideally, sites selected for cultivation should have a sandy loam five to six feet deep on top of a well drained subsoil. Unfortunately very little if any of this soil exists on Southern Vancouver Island, so growers must make the best of their situation. Through the use of properly installed tile drainage systems, soils with drainage problems can be greatly improved in many cases. Prior to planting vines growers should take drainage into consideration, and if in doubt they should contact a drainage contractor.



New field showing tile drainage

Water Requirements

Actinidia deliciosa plants are extremely vigorous, broadleaf deciduous vines. When they are carrying a full crop of fruit, and during the hottest part of our summer, mature vines can utilize up to 20 litres of water per day, depending on the orchard soil type.

If the site is in an area where early fall or late spring frost is a problem, an overhead frost protection system may also be advisable. This could increase water requirements dramatically. Consultation with BCMAF extension staff will enable prospective growers to determine water requirements based on protection and irrigation demand.

Varieties (Plant Material)

At present all the plants established in commercial plantings are the Hayward variety.

Almost all the plant material originated as grafted plants from California, since at the time of the initial plantings there were no plant suppliers in Canada. Some local nurseries are now producing vines grown from cuttings, and these are available as one-year-old plants.

It is advisable for commercial growers to use the oldest plants possible to shorten the interval until a crop is produced. For that reason the larger grafted plants from California will continue to be used in the establishment of most commercial plantings.

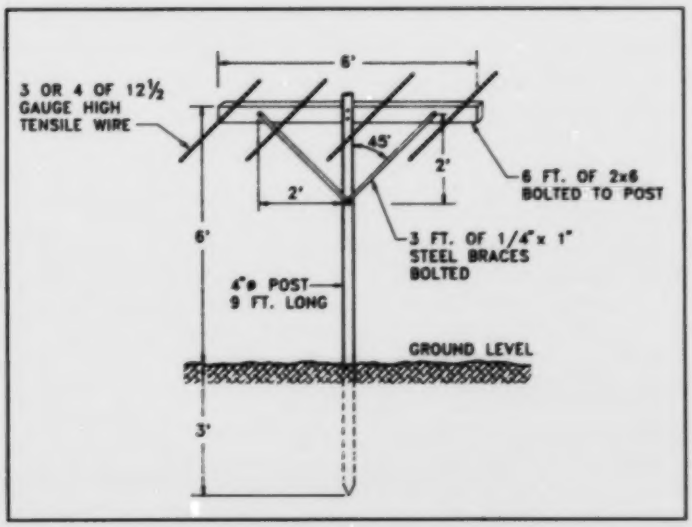
In areas where there is high risk of damage to young vines from frost, the benefits of cutting grown plants are the most obvious. If the plant is killed to the ground, root suckers growing the following year will be the same sex and variety as the above-ground portion that was damaged. This is not the case with grafted plants, and the resulting shoot from the root stock would have to be regrafted. Success rates for this procedure have ranged from extremely good to very poor, depending on the skill of the grower.

Other varieties such as Bruno, Abbott and Vincent have been fruited successfully on Vancouver Island and would appear to perform well under local conditions. At present consumers expect kiwifruit to look like the variety Hayward, and for that reason plantings of other varieties have not been recommended.

Support Systems

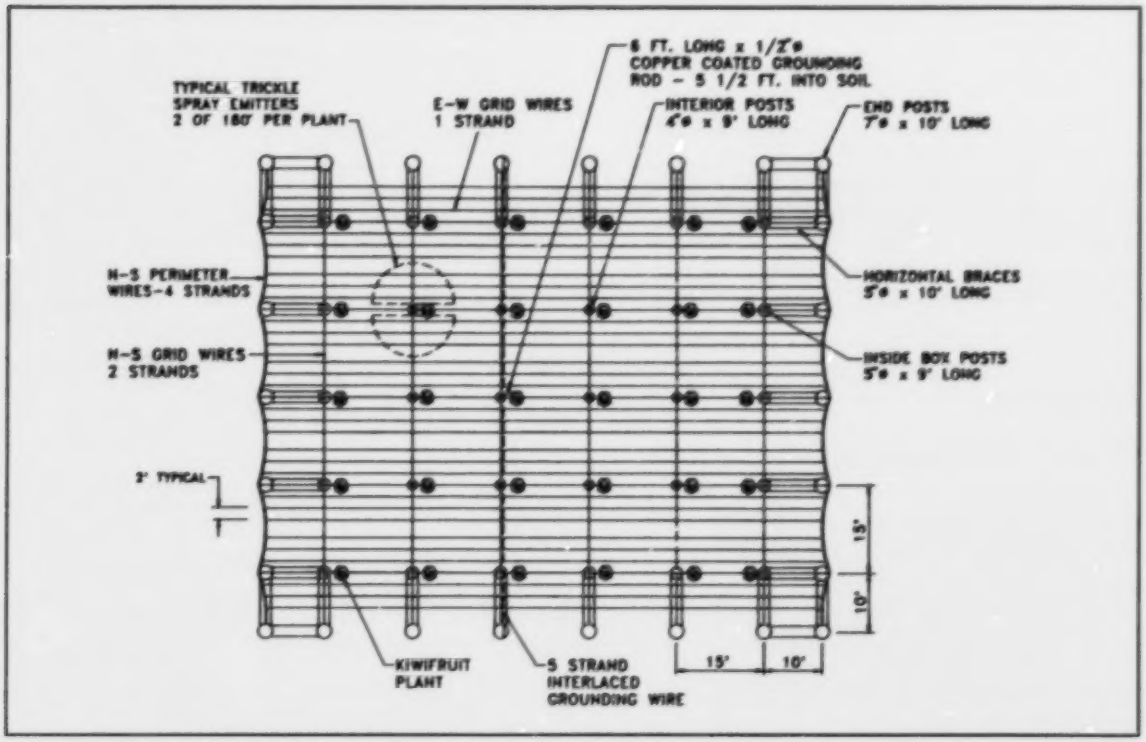
Since the kiwifruit vine is not self supporting, various methods of providing support have been devised, but currently only two methods are being used in B.C. Most B.C. plantings are trained on an overhead pergola system, but the T-bar system is equally effective.

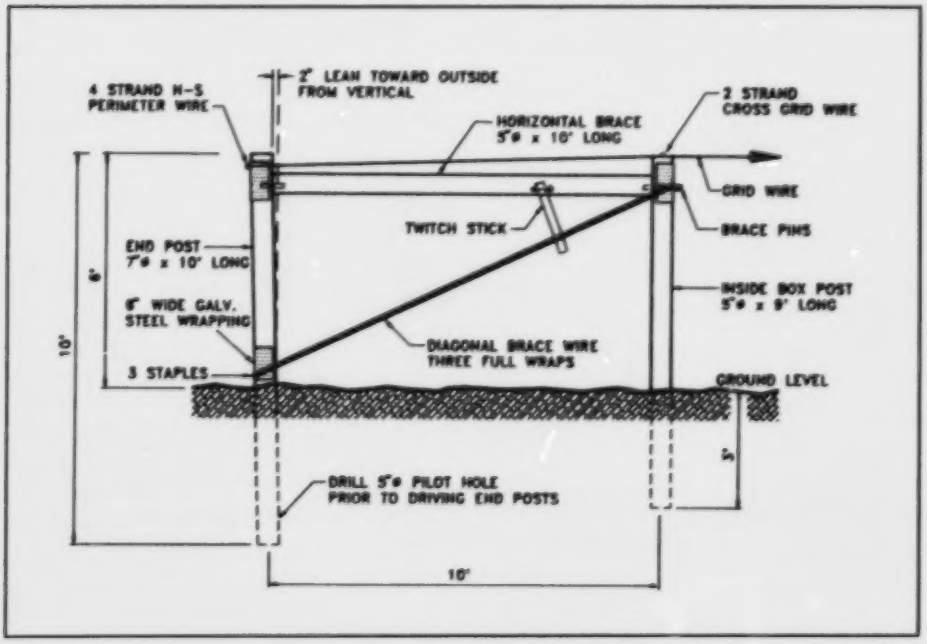
Both these systems have two main requirements: all posts in the ground must be pressure treated to prevent rotting and all wire must be high tensile galvanized steel (1/8" - 1/10"). Soft wire cannot be used because it is unable to support the weight of the crop.



T-Bar: *The schematic above illustrates the basic design for this type of planting. End assemblies should be the same for both plantings. This is a useful design for fields which do not form rectangles or squares.*

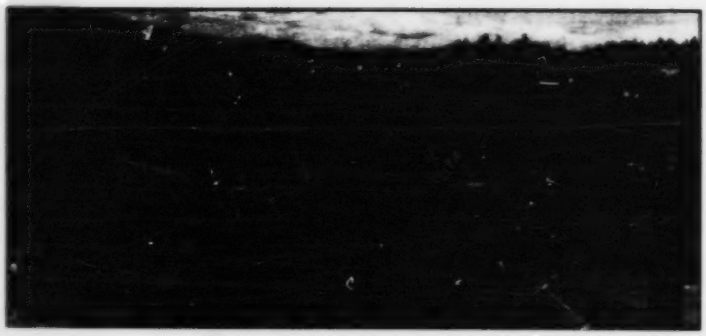
Pergola: *The schematic of a pergola, shown below, illustrates the post size required for this type of structure. When this system was designed by the BCMAF engineering staff, loading conditions were taken into account, so that if the crop is frost-protected with overhead irrigation, there should be no damage to the structure from the increased weight.*


6 FT. LONG x 1/2"ø COPPER COATED GROUNDING ROD – 5 1/2 FT. INTO SOIL
TYPICAL TRICKLE SPRAY EMITTERS 2 OF 180° PER PLANT
E-W GRID WIRES 1 STRAND
INTERIOR POSTS 4"ø x 9' LONG
END POSTS 7"ø x 10' LONG
H-S PERIMETER WIRES-4 STRANDS
H-S GRID WIRES 2 STRANDS
HORIZONTAL BRACES 5"ø x 10' LONG
INSIDE BOX POSTS 5"ø x 9' LONG
2' TYPICAL
15'
10'
KIWIFRUIT PLANT
5 STRAND INTERLACED GROUNDING WIRE
15'
10'


4 STRAND H-S PERIMETER WIRE
2" LEAN TOWARD OUTSIDE FROM VERTICAL
HORIZONTAL BRACE 5"ø x 10' LONG
2 STRAND CROSS GRID WIRE
GRID WIRE
BRACE PINS
TWITCH STICK
END POST 7"ø x 10' LONG
8' WIDE GALV. STEEL WRAPPING
3 STAPLES
DIAGONAL BRACE WIRE THREE FULL WRAPS
INSIDE BOX POST 5"ø x 9' LONG
GROUND LEVEL
DRILL 5"ø PILOT HOLE PRIOR TO DRIVING END POSTS
10'
10'

The Box End Assembly: *The illustration shows the requirements for this structure which can be used in both T-bar and pergola plantings.*

Pergola under construction, *(left) installing overhead wires*



Box end assembly, *(right) plants mid July at planting year*

Irrigation System Design

There is only one area of the world where kiwifruit are grown commercially without some form of supplemental irrigation — the west coast of the south island of New Zealand.

On Vancouver Island, irrigation water is needed in June, July and August, and is occasionally required into late October.

Due to problems with fruit staining when overhead water is used, vines are normally irrigated under the canopy by some form of drip or mini-sprinkler system. Heavier loam soils can be irrigated successfully with individual drippers, but drippers should be avoided in lighter soils due to the poor lateral movement of water in the soil. During the heat of summer, mature kiwifruit vines under full crop can use more than 20 litres of water per day. Heavier soils and mulching could reduce this demand significantly. Irrigation system design should be planned in consultation with BCMAF staff or a qualified irrigation firm.

Planting

Site Preparation

After drainage problems have been addressed, the soil should be sent for analysis to determine the pH and nutritional status.

The pH of the soil for kiwifruit production should be between 6.0 and 7.0. In the coastal region it is very likely that lime will have to be added to reach this level. During the summer prior to the planting year the land should be subsoiled, ploughed and disced to keep down the weeds. The following winter any soil amendments determined to be necessary by the soil analysis can be made.

The field can then be rototilled in preparation for grass to be sown between the rows of vines. The current recommendation for this grass cover crop is one of the newly-released dwarf perennial rye grasses, such as Elka or Manhattan. This grass can be established either the year prior to planting or in the planting year.

Male-Female Ratio

Current recommendations suggest that vines be planted at a ratio of no greater than one male to every six females. Ratios of 1:5 are more common.

Since almost all the plantings in B.C. use a pergola training system, the practice of training male over female vines (formerly common in New Zealand), is not recommended.

A typical 1:6 (male:female) ratio planting is illustrated below.

F	F	F	F	F	F	F	F	F	F
F	M	F	M	F	M	F	M	F	M
F	F	F	F	F	F	F	F	F	F
F	F	F	F	F	F	F	F	F	F
F	M	F	M	F	M	F	M	F	M
F	F	F	F	F	F	F	F	F	F
F	F	F	F	F	F	F	F	F	F
F	M	F	M	F	M	F	M	F	M
F	F	F	F	F	F	F	F	F	F
F	F	F	F	F	F	F	F	F	F

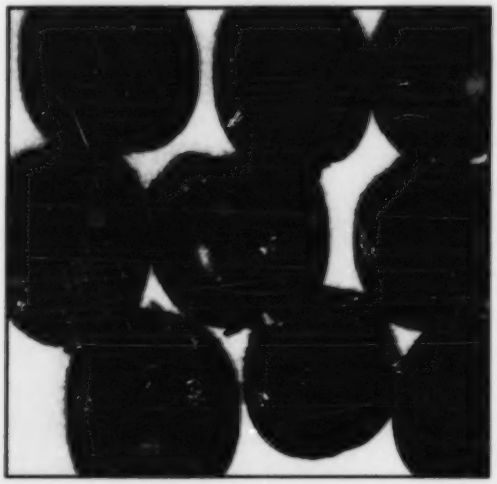
Growers who have artificial pollination equipment or intend to use some form of this technology may be able to reduce or eliminate male plants. Any grower considering such a planting should discuss the options with BCMAF personnel.

Pollination

Kiwifruit are dioecious vines, which means that male and female flowers are borne on separate plants. For pollination to take place, there must be an adequate ratio of male to female plants.

Female Flower

To obtain marketable fruit size, the fruit must be well pollinated and contain somewhere in excess of 800 to 1,000 seeds.



Fruit showing different abnormalities,
mainly related to poor or inadequate pollination

Currently the male plants being grown are either the Chico-Hayward male or the California all-purpose male. Neither appears to have the advantage in bloom dates or flower numbers. There are some new male clones available from New Zealand which are reported to produce larger, more viable amounts of pollen, but these have not yet been tested under our growing conditions.

The vines bloom over a period of 10 days to two weeks, starting in mid June. Most of the pollination is carried out by honey bees (Apis mellifera), but large numbers of bumble bees (Bombis terristris) have been observed working the flowers in several plantings.

The kiwifruit flowers are not attractive to honey bees since they contain only pollen and no nectar. Therefore it is essential that hives be managed properly so they are in need of pollen to feed the brood. Local beekeepers must be made aware of this situation for hives to be their most effective.

Flower Structure

The female flower produces pollen but it is nonviable, so male plants are essential for pollination.

To be successfully pollinated, a female flower must produce between 800 and 1,000 seeds. According to scientific studies this cannot be accomplished by a single bee visit, but requires multiple visits.

Individual male flowers only remain viable for two to three days but individual female flowers are receptive up to five days (these figures apply only to field-grown plants).

Pollen liberation (dehiscence) begins as early as 8 a.m. but under normal local conditions may be delayed a couple of hours due to low early morning temperatures and high humidities. The majority of the collection is usually completed by 2 p.m., with the peak period being at midday. Based on observations made on Vancouver Island in 1988, which confirmed previous work done in New Zealand, bees prefer collecting female pollen to male pollen. When pollen traps were used in 16 bee hives at a commercial field, it was found that only three percent of the pollen collected over the entire flowering period was male pollen. Therefore it is critical to ensure that there are adequate hives in the orchard, so there is pressure on the hives to collect all the available pollen, including the male pollen. Recent work shows that much of the pollen transfer occurs within the hive as foraging bees return to unload their baskets. As the bees make their way through the hive they are dusted inadvertently with pollen from other bees. This pollen is then deposited on flowers in the orchard when the bees return for the next load of pollen.

Hive Management

There are several important 'dos' and 'don'ts' to consider in managing beehives:

1. Do not bring the hives into the planting until at least 10 percent of the female flowers are open, otherwise the bees will establish foraging patterns away from your planting, and when the flowers do open, the bees will be feeding elsewhere.
2. Only strong healthy hives should be used. Colonies should have at least four supers of bees and the average strength should be between 30-40,000 bees.
3. Hive numbers must match the stage of development of the orchard. Mature plantings require four to five hives per acre. Younger plantings should be judged on the percentage of canopy development, not necessarily age. A planting with 50 percent canopy development should have two to three hives, and so on. Oversupply of bee hives will cause the bees to forage elsewhere, reducing the effectiveness of the pollination.
4. Eliminate any competition from weeds in the orchard by mowing prior to hive placement.
5. As soon as the bloom is over, have the hives removed from the planting.
6. Pesticide poisoning of bees should not be a problem since currently there are no insecticide or fungicide sprays registered or recommended for application in local orchards. Growers located next to farms where sprays are being applied should confer with neighbouring farmers to ensure that foraging bees will not be affected by their operations.

Artificial Pollination

Due to the need for large seed numbers to ensure adequate fruit size and the unattractiveness of the kiwifruit flower to the honeybee, considerable research is being devoted to artificially pollinating these flowers.

Initial studies have been done using dry application methods. One of these systems has been patented and is available in North America and New Zealand.

***The "Airflow" pollinator machine** used for pollen delivery in a greenhouse of all female vines*

The Airflow Pollinator (shown) will collect male pollen, hold it in suspension in a cyclone chamber, and then gradually disperse it through hoses operated by up to four workers. In pollination work done during 1988 both in the field and in the greenhouse on Vancouver Island, the unit was effective. The high cost associated with this unit ($4,500 Cdn.) puts it out of reach of smaller growers.

Other application methods have attempted to apply the pollen in a liquified suspension, which would enable the use of conventional spray equipment. One such system has been patented in New Zealand through Turners Horticultural Suppliers under the licensed name of Pollen Aid. However this system is also extremely expensive and therefore not economically feasible for small orchards.

The major costs involved in artificial pollination have been to this point associated with the collection of the male pollen. Currently research is being conducted in various areas of the world to determine methods of utilizing bee-collected pollen. Once the technology is refined, artificial pollination of many crops may become standard practice instead of the exception.

Pruning

In order to produce good quality and large numbers of kiwifruit, vines must be maintained in a vigorous condition, and pruned on a regular schedule. For most farms, this will involve one dormant pruning and two or possibly three summer prunings.

Without proper pruning, kiwifruit vines will rapidly become overgrown and flower bud numbers will decline, decreasing numbers and quality of fruit.

Principles

The most important factor to remember when pruning kiwifruit is that the plants produce fruit on current season's wood, which is produced off the previous season's growth. This is very similar to peaches and raspberries. Ideally, dormant pruning becomes a simple process of replacement cane pruning.

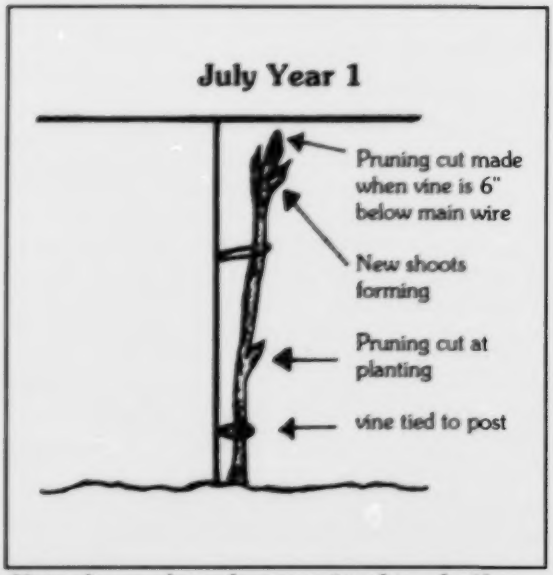
However since all the vines do not perform exactly the same, some two-year-old wood normally has to be left farther out from the cordon. The new wood originating from this two-year-old branch will also produce fruit, but it will be farther away from the main cordon. This leaves a blank space, which is not desirable.

This cannot be allowed to occur on the entire vine, or the fruiting area will move farther and farther away from the main cordon. With young vines some fruiting on two-year-old wood can be acceptable, since all parts of the plant are still being fully exposed to the sun.

Pruning Young Vines

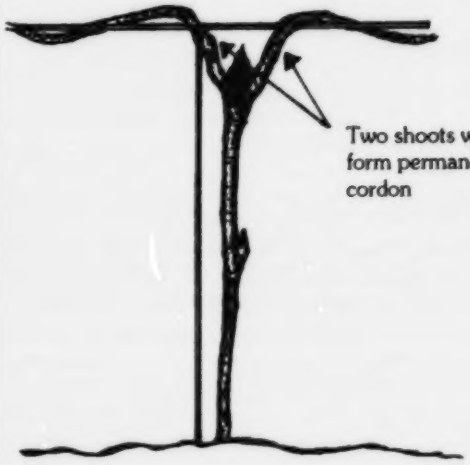
Dormant vines can be planted in most regions of South Coastal B.C. in March and April. These vines should be trained as a single trunk up to the main wire, regardless of whether the training system is to be a T-bar, pergola, or some other system.

Once the vine is within one foot of the cordon wire, the growing point should be removed. This will stimulate the growth of the lateral buds. Two of these should be selected to train as the opposing cordons. These shoots will then grow along the wire during the first growing season. If the growth is very good, the tips of the shoots should be removed after they have grown 15 to 20 inches along the wire. This will allow the formation of lateral branches for fruiting the subsequent year.



Note: leaves have been omitted to clarify drawings

September Year 1



During the dormant season the canes should be pruned back to where the wood is the thickness of a pencil. Any wood which has spiralled around the wire should be removed.

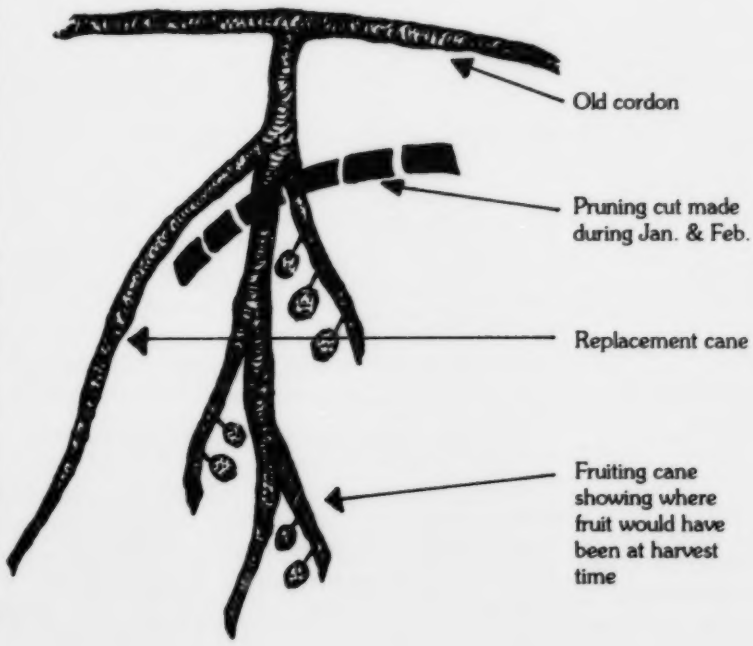
Second Leaf and Beyond

When the vines leaf out, they will send out a series of laterals, a few of which may have a small number of fruit.

These fruiting laterals should be spaced approximately 12 inches apart on the cordon. More laterals than this will result in overcropping. In young vines this can seriously affect subsequent crops. All crossing branches should be removed so that each fruiting arm is fully exposed to the sunlight.

Fruiting canes on mature plants should be allowed to fill the space allocated and then be tipped. For the pergola, this would mean running to the middle of the row. On the T-bar the vine should come off the outside wire and reach down to approximately knee height.

Replacement Cane Pruning


Old cordon
Pruning cut made during Jan. & Feb.
Replacement cane
Fruiting cane showing where fruit would have been at harvest time

Any of these canes which carried fruit should be cut back to 2-3 leaves beyond the last fruit. This will stimulate a replacement cane for the following year. Strong bull shoots which appear early in the summer should be cut back to 2-3 buds to encourage weaker shoots later in the season, which will have a greater fruiting potential.

Timing

Dormant pruning should be done before the end of February for most areas of south coastal B.C. Pruning after this period becomes risky due to increased sap flow.

***Third year planting** being pruned in mid January*

The first summer pruning should be done as soon as the fruit is set. At this time strong bull shoots can be cut back and fruiting laterals pinched to within two leaves of the last fruit to stimulate replacement canes.

Subsequent summer prunings may have to be undertaken in more vigorous plantings.

No summer pruning should be carried out after August 1. Pruning after this date could stimulate late growth in the fall which would not only be killed by the first frosts but might also keep the vine from going dormant, thereby making the entire vine more susceptible to fall frosts.

Cropping

One of the most serious mistakes made by all new kiwifruit growers is overcropping of their young vines. Overcropping creates problems with fruit quality in that particular year and also has a tremendous impact on the growth and fruiting of the vines in subsequent years. Depending on plant spacing, mature female vines should have between 30 and 40 fruiting canes per year and should yield approximately 1,000 fruit. In most cases, plants carrying more fruiting canes or more fruit will have small fruit. Second year vines should not carry more than 50 fruit and all misshapen (flats, fans, triples) or poorly pollinated fruit should be removed.

Male Plants

Although no fruit is produced on these plants they are as important to the planting as the female vines. For this reason care should be taken to keep them pruned and confined to their space.

Most of the pruning on male vines is done immediately after flowering. This enables the plant to generate a large amount of one-year-old wood, which will carry the flowers for the next season. If this practice is continued, very little pruning will be required in the winter. However older vines which have not been pruned correctly will require large limb removal. This should be done during the dormant season.

The structure of a male vine should be essentially the same as a female vine, with two cordons, and flowering laterals from these being replaced annually.

Fertilization

Before planting, a complete analysis of the soil should be done to assess soil acidity and availability of nutrients. The ph of the soil is critical and must be between 6.0 and 7.0 to allow for proper nutrient uptake.

Listed below are general guidelines for tissue results from producing vineyards.

These guidelines are based on work done by Dr. Jim Beutel in California and Pat Sale in New Zealand, and on four years of soil and tissue testing in B.C. vineyards. Barring any other problems, vines testing within these ranges should produce large crops of good quality fruit.

Recomended Kiwifruit Tissue Analysis Ranges

Nitrogen (N)-	2.5%-3.0%	Zinc (Zn)	12-30 ug/g
Manganese (Mn)	50-200 ug/g	Iron (Fe)	12-30 ug/g
Potash (K)	2.0-3.0%	Boron (B)	30-90 ug/g
Magnesium (Mg)	>.1.0%	Calcium (Ca)	>.20%
Phosphorous (P)	.13-.3%	Copper (Cu)	n/a
Sodium (Na)	trace		

Young kiwifruit vines are extremely vigorous and for that reason require large appalications of nitrogen fertilizer throughout the growing season. Depending on the size of the vine, one to two ounces of nitrogen would typically be added per month in May, June, and July. Phosphorous and potash applications are usually minimal until the vines begin to set fruit. This will begin in the second and third leaf, when larger amounts of these elements must be applied.

Since there are currently no mature plantings in B.C., fertilization recommendations based on local vines are unavailable. However, fertilization of younger vines has been similar to other kiwifruit-growing areas, and therefore recommendations published by Pat Sale should serve as a guideline.

These are as follows:

N.	150 lbs./acre	- 2/3 March, 1/3 May
P.	50 lbs./acre	- Feb/March
K.	70 - 90 lbs./acre	- Feb/March

Before planting, a complete soil analysis should be carried out to assess the soil acidity and availability of nutrients. In coastal B.C. soil pH tends to be in the 5.0 to 6.0 range. This is too low for kiwifruit production and the soil pH should be raised to the 6.0 to 7.0 range. A soil testing lab will make recommendations as to the amount of lime required.

The fertilizer and lime should be spread evenly over the entire managed area so that large concentrations of fertilizer do not burn the roots. The majority of the small feeder roots of the vines are located in the top foot of the soil and are extremely sensitive to excessive fertilization. **Fertilizer must not be applied within one foot of the trunk.** Accumulations of fertilizer at the base of the vine may severely damage the crown area, killing the vine.

Organic Fertilization

Kiwifruit can be grown successfully using animal manures or fish fertilizers provided they are applied at the proper time and in adequate amounts.

Soil sampling is essential to determine what is happening over time to the nutrient levels. Yearly testing is advisable.

Well-aged manures can be used at any time of year, but fresh manures should be applied sparingly and only during April, May and June. Earlier fertilization could cause root damage and later fertilization could prevent the plants from going into dormancy.

Exact rates are difficult to recommend since manures contain varying amounts of nutrients. The following table shows average values for the most common animal manures.

	N	P2O5	K2O
Cow Manure	Good 2.5 (5)	1.5 (3)	4.0 (8)
	Poor 1.0 (2)	0.5 (1)	3.0 (6)
Poultry Manure	Good 5.0 (10)	3.0 (6)	4.0 (8)
	Poor 3.0 (6)	2.0 (4)	3.0 (6)

kg. per tonne of manure
(lbs. per ton of manure)

Remember: it is essential that manure not be applied after the end of June, to allow the vines to gradually enter dormancy.

Horse manure is unlikely to have enough nitrogen to maintain fully-mature kiwifruit vines unless it is applied very heavily. In addition, manures generally contain large numbers of weed seeds. The resulting weeds will have to be controlled.

Weed Control

When they are first established, kiwifruit vines must be protected from competition from both weeds and seeded grass between the rows. In other countries, contact herbicides such as paraquat (Gramoxone) and glyphosate (Roundup) are used for this purpose, provided the trunks are protected from overspray. Currently there are no herbicides, insecticides or fungicides registered in Canada for kiwifruit production.

No soil-acting herbicide registrations are expected since most of the root system is within the top 12 inches of the surface and could be seriously damaged by incorrect application of these compounds.

Cultivation

Cultivation is not recommended due to the closeness of the roots to the soil surface.

Mulches

Vines can be successfully grown under a porous plastic mulch or landscape fabric. This material can be secured by tucking it into the soil at the edge of the grass aisle. Thinner plastics such as the one mm porous material used in vegetable production must be covered with a thin layer of sawdust or bark to prevent ultra-violet deterioration of the plastic. Sawdust or bark mulches can be used but they will deteriorate after one or two years, allowing weed growth. As mulches deteriorate they remove nitrogen from the soil, necessitating addition of fertilizers, particularly nitrogen. All other heavier plastics or landscape fabrics used should be UV-stabilized, or their life expectancy will be only one or two years.

Grass Aisles

In order to facilitate working in the planting during wet periods and to prevent erosion and compaction, most kiwifruit growers around the world establish grass cover crops between the rows, regardless of the training system.

In this area, the recommended grasses are dwarf perennial rye grass varieties such as Elka or Manhattan or any other type of dwarf perennial turf rye grass.

Pest And Disease Control

Insects

To date, very little insect damage has occurred in B.C. kiwifruit vineyards.

Some leaf roller damage has been observed on both leaves and fruit, but in all cases damage has been less than one percent total fruit damage — not significant enough to warrant control measures.

Damage consists of leaves webbed together or fruit which has had a small hole bored into it. Fruit damage generally occurs only when two fruit are touching.

Some damage has been observed on young vines from root weevils and slugs, both of which feed on newly-developing buds on young plants. This can be a serious problem if the infestation is heavy enough to remove the majority of developing buds on a one- or two-year-old vine.

Vertebrate

The greatest potential for plant loss in our area is from deer or rabbit damage. Several plantings have suffered extensive leaf and shoot removal, bark removal and even plant death due to heavy browsing by native deer. Other plantings have had vines girdled at the ground level or slightly above by rabbits feeding in the winter. Mice can also be a concern if trunk protectors are used during the winter. Depending on the type of protection installed, the mice may overwinter under the wrap and feed on the bark.

Installing physical barriers is the only way to control these pests. A high-tensile electric fence is the most economical barrier for deer. Rabbits can be controlled effectively by installing plastic or wire tree guards around the trunk of the developing vine.

If plantings are close to residential developments, household cats may become serious pests. Young vines can have buds removed and bark torn to shreds by these animals, which find a chemical in the sap extremely attractive. Cats react in the same way to kiwifruit leaves or bark as they do to catnip.

Winter Injury

Unlike most other areas where kiwifruit is cultivated, south coastal B.C. can have winters severe enough to cause damage and even death to unprotected vines.

Young vines, particularly those in the second or third leaf, are especially susceptible to early fall frosts or late spring frosts. Rarely will extreme winter temperatures be severe enough to affect mature vines. The first commercial kiwifruit plantings in B.C. were established in 1985. The plantings grew extremely well, but due to a very long mild fall, did not go into dormancy soon enough. In mid-November, actively growing young vines were exposed to temperatures as cold as -16C, and some plantings were killed to the ground.

***Winter damage**, above top of foam collar*

The next two winters were mild and no significant losses ocurred. On January 31,1989, temperatures dropped to -20C in the Fraser Valley and -16C on Vancouver Island. At the same time there were winds of 50 mph gusting to 100 mph for two days. Remarkably the only serious losses occurred in a planting in the Fraser Valley where the trunk protectors were blown off by the high winds. At this site approximately 50 percent of the plants were killed to the ground.

Protection

In order to prevent a recurrence of this type of damage, protective measures were assessed in a project involving staff from the Ministry of Agriculture in New Zealand, Agriculture Canada and the BCMAF.

After two years of testing, it has been established that the most economical material in terms of initial cost, application ease and reusability potential is a type of high density foam. This material is used by the foam mattress industry and is a byproduct of the manufacturing process. It generally comes in four-by-eight foot sheets, 1/4 to 3/4 inches thick, and is waterproof on one side. The waterproof side is placed against the plant trunk to prevent moisture in the foam from staying in contact with the trunk over an extended period of time. If possible, these protective sleeves should run from the ground to the cordon wire. If they do not, the trunk should be painted white from the end of the foam to the cordon wire to prevent southwest heating in the winter. The sleeves should be installed at least one month prior to the first frost (historically Sept. 15 in southern B.C.) and be left on until all frost risk is over, usually in mid-May.

***Foam Insulation** must be white*

The only other effective type of protection is overhead irrigation. Overhead irrigation systems are expensive to install and require large volumes of water. Before proceeding, growers should contact BCMAF staff to determine whether such an investment is warranted. Overhead irrigation is most effective when used to protect the vines at night in situations where temperatures drop below freezing for a number of hours but quickly rise above freezing the following morning. If an extended freeze of more than 24 hours is expected, overhead water should not be used, since serious damage can occur to both plants and trellis systems from the weight of the ice.

***Overhead irrigation** for frost protection*

Both of these systems are designed to slow the rate of temperature change, but <u>will not</u> protect against cold temperatures over a period of time.

Mature kiwifruit vines which are fully dormant have been exposed to temperatures of -16C in Europe without fatal damage. During the winter of 1985, mature vines at Saanichton were exposed to -12C and suffered minor damage even though they weren't fully dormant. Fully dormant vines which had their trunks protected survived -20C in the winter of 1988-1989 in B.C., but did have some bud loss on the fruiting canes.

Reworking Damaged Vines

All the vines which originally came from California were grafted onto Bruno seedling rootstock. While this makes for a very vigorous, well-rooted plant, if the upper portion is killed by frost, the root suckers which regrow are useless for commercial production and must be regrafted. This has been done with varying success locally, and is recommended as the quickest way to get a damaged vine back into production. Depending on the size of the rootstock, cleft, whip and tongue, or bark grafts have all been successful in reworking field-grown vines.

Yields And Harvesting

The following table shows approximate yields per female vine. The data is based on yields of two-year-old grafted plants from California.

Age	Yield (fruit/vine)
1st leaf	0 - 5
2nd leaf	50 - 75
3rd leaf	200 - 400
4th leaf	600 - 800
5th leaf	800 +

On average 85 percent of the crop has been tray-packed fruit.

Based on growth achieved on the earlier vines established, current spacing recommendations for a pergola are10 by 15 feet, 290 vines per acre, or 240 female vines per acre.

Maturity Testing

Kiwifruit are not allowed to ripen on the vine prior to harvesting since mature fruit has a short shelf life. Maturity is assessed by measuring the percent soluble solids (%SS) with a hand-held refractometer. These instruments are available for approximately $200 and all growers should have one.

Starting in early October, weekly samples of at least 10 fruit taken from different vines across the orchard should be collected for testing. Do not sample vines on the edge of the planting because these fruit tend to ripen early. Slices should be removed from both ends of the fruit and an equal number of drops of juice from each slice placed on the prism. Record the readings, then clean the instrument with distilled water and a soft cloth prior to testing the next sample.

Percent soluble solids readings in a normal year should reach 6.0 towards the middle of October. New Zealand growers start to harvest when %SS reaches 6.2. However at this sugar reading their fruit is also much more mature than ours, having been on the vine approximately one month longer. We have not been able to produce high quality, sweet fruit if it is picked at this stage. For that reason, no fruit should be harvested until all tested fruit from the orchard attains a reading of 7.0 percent.

If fruit is to be retailed directly to the marketplace or only held in short term storage, it should be left on the vine as long as possible. On the Saanich Peninsula it can be left on the vine until mid-November, at which time the %SS should reach 9.0 to 10 percent. After this fruit is placed in cold storage for four to five weeks it will be ready to ship to market.

Fruit picked at 7.0 to 9.0 %SS will have to be stored for a longer period in order for soluble solid levels to be acceptable, unless some form of accelerated ripening is utilized.

Pressure

Another means of gauging fruit ripeness is to measure the decline in pressure of the fruit. This is a serious concern in California even before harvest, but not a problem in our climate. Fruit coming out of cold storage must be tested, since as it ripens the pressure does decline and the minimum flesh pressure for shipment to the marketplace is 2.2 pounds or 1.0 kilogram.

Packaging

Currently growers are packing the larger portion of their crop in the conventional wooden trays. Retail chains have been requesting larger volumes of fruit in bulk containers (ie. 10 Kg boxes) and it is expected that this will be how the majority of B.C. fruit is packed in the future.

***Fruit** entering grading line at Vantreight Farms*

***Vantreight Farms** exhibiting 1987 tray packed fruit*

Storage

Once it is harvested, fruit should be placed in cold storage at a temperature just above 32F (0C). Picking is done so late in the fall that fruit temperature is cool enough so field heat removal is not a serious problem. Therefore it is not necessary to precool individual bins of fruit. Humidities must be maintained at 95 percent or higher which means plastic liners must be placed in both the bulk packs and trays. Without high humidity the fruit will quickly shrivel.

In storage kiwifruit should be kept away from sources of ethylene gas, since this will hasten the ripening of the fruit. No other fruits (particularly apples and pears) should be in the same storage room or even in the same building, unless all the rooms are completely airtight.

Forklifts used to move bins and pallets should be electric or manual, because combustion engines generate ethylene gas, causing premature fruit ripening.

At present the local industry is small, so the crop is not held for long periods in storage. As a result it has not been necessary to purchase expensive ethylene monitoring equipment.

Greenhouse Kiwifruit Production

Tremendous interest has developed in cultivation of this crop in areas of Canada where the vines will not survive winter temperature extremes.

Even in British Columbia, based on historical weather data, the only area where there is essentially no danger of the entire planting being frozen in any given year, is the extreme south end of Vancouver Island. In areas further north on Vancouver Island and in the Fraser Valley, kiwi plantings will survive all but our most severe winters if they have some winter protection. However in all other areas of B.C. and the rest of the country these vines must be protected by some type of heated structure to survive the winter.

Very little work was done on this type of kiwifruit culture until the early 1980s, when a small industry began in the Channel Islands. At that time kiwifruit were being planted in glass greenhouse ranges, which up until then had housed tomatoes. Initial yield and quality data were very encouraging, with estimated mature yields approaching 25 tons per acre, or more than 6,500 wooden trays, each weighing 7.5 pounds, per acre. At that time the wholesale price ranged between $16 and $22 Canadian for a tray.

In 1981 scientists at the Horticultural Research Institute of Ontario in Vineland began a study of greenhouse production of fruit, including kiwifruit. The program was directed by Dr. Neil Miles and Ken Slingerland.

The vines have been maintained since 1981 and data collected on vine growth, fruit yield and fruit quality.

Listed below is the harvest data from Dr. Miles' work, which corresponds closely to the work done in the Channel Islands.

Tonnes/ha (tons-acre)

Year	Annual	Accumulated
1981	-	-
1982	-	-
1983	4.8 (2.2)	4.8 (2.2)
1984	19.1 (8.6)	23.9 (10.8)
1985	46.9 (21.1)	70.8 (31.9)
1986	36.6 (16.50)	107.4 (48.3)
1987	59.1 (26.6)	166.5 (74.9)

These yields are significantly higher than yields expected from field-grown plants. Expected yield from the best mature plantings in other countries is 15 tons per acre.

Due to the increased humidity and lack of wind in the protected structures, the quality of fruit produced is also much better. This means that as much as 90 percent of fruit harvested can be tray packed, with the other 10 percent being made up of culls and small fruit.

During the summer of 1986 two greenhouses were planted with kiwifruit vines at the Agriculture Canada Plant Quarantine Station in Sidney. Since that date, growth and yield data has been collected and the plants have been used in artificial pollination experiments to determine which is the most cost-effective method of applying pollen.

Planting in a Greenhouse

Due to the almost perfect growing conditions in a greenhouse, the vines are more vigorous and therefore require more space. Currently, the recommended plant spacing is 10 by 15 feet. This will maximize the growing area and enable the plants to come into production in the second year, provided two-year-old grafted plants are obtained initially.

Greenhouses are planted entirely with female vines to make maximum use of the production area. At present pollen can be obtained from commercial sources in California. In the future, it may be available freeze-dried or frozen from New Zealand.

Pollen can be applied in either a liquid or dry suspension with one of the commercial machines discussed in the pollination section.

Greenhouse Structures

Current crop returns indicate kiwifruit can be grown in the protected environment of a greenhouse and be economically viable. Dr. Miles' work follows a planting from from the first to the twenty-fifth year and shows a positive cash flow by the fourteenth year. However if a structure cost less than the greenhouse used in the study, a positive cashflow could be realized much earlier. Two commercial greenhouses have been built in B.C. one in Maple Ridge and one in Courtenay. Both these growers have used wooden structures with plastic covering to reduce the initial capital expenses. No figures are available yet on these operations.

World Crop Outlook And Pricing

Production Forecast

Principal countries of production:
(expressed in tonnes)

	1987	1990
New Zealand	189,000	300,000
Italy	80,000	200,000
Chile	7,000	171,000
France	20,000	70,000
Japan	33,000	65,000
United States	23,814	44,000
Spain	1,100	16,000
Australia	7,000	5,000
Canada	1,380	3,000
Total	362,294	884,000

Source: Fruit Trades Journal, Oct. 24, 1988

The Canadian figures are extremely high (more than seven million pounds by 1990) which is a completely unrealistic projection. However the figures do give some idea of how much fruit is currently available from the major producing countries in the world.

Prior to 1981, kiwifruit prices and therefore returns to growers were very high, with individual trays selling for more than $23 in the Vancouver wholesale market. Prices have fallen drastically due to increased worldwide production. Consumption has also been increasing dramatically (more than 1,000 percent in North America in the past five years) but this increased demand has not been able to maintain the price.

During the 1987/88 crop year, the average price for the B.C. crop was $9.80 per tray. In 1989 there was another significant decline in wholesale prices due to large worldwide crops and at present it appears the wholesale price in the Canadian market will average between $8.50 and $9. This decline in prices should be taken into consideration by growers planning to grow kiwifruit in a greenhouse.

Costs of Production

Based on information from B.C. producers, the Farm Management Branch of the BCMAF has put together some financial data for kiwifruit. Included at the end of this pamphlet is a 12-year estimated income and expense statement based on a return of $1.20 per pound (1988 returns). More detailed information is available from district or regional BCMAF offices.

Nutritional Information

North Americans are becoming increasingly aware of the importance of proper nutrition. As a result, kiwifruit have enjoyed rapid acceptance by consumers. Not only do kiwifruit taste good, they are among the best buys nutritionally in the produce section. With more crude fiber than a cup of bran flakes and more vitamin C than an orange of comparable size, kiwifruit are definitely a welcome addition to most diets.

Nutritional Information Per Serving

Serving size (meat of 2 average fruit)	140 grams
Calories	90+
Protein	2 grams
Carbohydrate	18 grams
Fat	1 gram
Cholesterol	0 mg
Sodium	0 mg
Potassium	450 mg

Percentages of U.S. Recommended Daily Allowances

Protein	2
Vitamin A	2
Ascorbic Acid	230 g
Thiamin (Vitamin B1)	Trace
Riboflavin (B2)	2
Niacin	2
Calcium	4
Iron	4
Vitamin E	10
Vitamin B6	4
Folic acid	8
Phosphorous	2
Magnesium	6
Copper	8
Pantothenic Acid	2
Crude Fiber	2500 mg

Source: California Kiwifruit Commission

***"Ian Vantreight, President, Kiwifruit Growers Association of B.C.**, with 1987 crop display at Thrifty Foods, Sidney B.C."*

Size	5 acres
Hand Picked	100%
Hand Picked	$1.20 per lb

Kiwifruit Production - Vancouver Island
Projected Income Statement
Per Acre

June - 89

	Yr 1 - Prep	Yr 2 - Plant	Yr 3	Yr 4 - Crop 1	Yr 5 - Crop 2	Yr 6 - Crop 3
INCOME						
Yield (lbs)	0	0	0	1,800	3,600	7,200
Average Price ($/lb)	$0.00	$0.00	$0.00	$1.20	$1.20	$1.20
TOTAL INCOME	0	0	0	2,160	4,320	8,640
EXPENSES						
Plant Nutrients	70	15	172	152	222	152
Pesticides	30	30	30	30	30	30
Fuel, Oil, Lubrication	0	2	6	10	26	42
Equipment Repairs and Maintenance	226	351	351	351	351	351
Hand Picking	0	0	0	54	108	216
Hired Labour	0	1,044	1,149	1,437	1,615	1,794
Marketing	0	0	0	120	240	480
Contracts and Custom Work	210	75	0	0	0	0
Rentals	0	0	0	50	75	100
Cartons and Packing	0	0	0	660	1,320	2,640
Irrigation (hydro and water)	0	290	290	290	290	290
Other (cold storage, max tape)	0	0	0	410	795	1,540
Land Lease	0	0	0	0	0	0
Building Repairs and Maintenance	36	36	36	36	36	36
Land, Water, Dyking Taxes	148	148	148	148	148	148
Legal and Accounting	100	100	100	100	100	100
General Insurance	200	200	200	200	200	200
Crop and Income Insurance	0	0	0	0	0	0
Utilities	0	20	20	20	20	20
Miscellaneous	120	120	120	120	120	120
Operating Interest	54	307	115	179	241	345
Term Loan Interest	2,054	1,829	1,802	1,770	1,735	1,696
TOTAL EXPENSES	3,247	4,567	4,539	6,137	7,672	10,300
EXCESS INCOME OVER EXPENSES	-3,247	-4,567	-4,539	-3,977	-3,352	-1,660
Less Depreciation						
Plants* and Hedging Plants	0	223	223	223	223	223
Buildings and Improvements	220	220	220	220	220	220
Equipment	867	983	983	983	983	983
NET FARM INCOME	-4,333	-5,992	-5,964	-5,402	-4,778	-3,085

* For this example, kiwifruit plants cost (290 plants x $13 per plant) $3,770 per acre. This cost should be included with a cashflow budget.

Size	5 acres
Hand Picked	100%
Hand Picked	$1.20 per lb

Kiwifruit Production - Vancouver Island
Projected Income Statement
Per Acre

June - 89

	Yr 7 - Crop 4	Yr 8 - Crop 5	Yr 9 - Crop 6	Yr10 - Crop 7	Yr11 - Crop 8	Yr12 - Crop 9
INCOME						
Yield (lbs)	10,800	14,400	18,000	21,600	25,250	25,250
Average Price ($/lb)	$1.20	$1.20	$1.20	$1.20	$1.20	$1.20
TOTAL INCOME	12,960	17,280	21,600	25,920	30,300	30,300
EXPENSES						
Plant Nutrients	222	152	222	152	222	152
Pesticides	30	30	30	30	30	30
Fuel, Oil, Lubrication	58	74	90	106	122	138
Equipment Repairs and Maintenance	351	351	351	351	351	351
Hand Picking	324	432	540	648	758	758
Hired Labour	1,973	2,151	2,330	2,509	2,687	2,866
Marketing	720	960	1,200	1,440	1,683	1,683
Contracts and Custom Work	0	0	0	0	0	0
Rentals	100	100	100	125	125	125
Cartons and Packing	3,960	5,280	6,600	7,920	9,258	9,258
Irrigation (hydro and water)	290	290	290	290	290	290
Other (cold storage, wax tape)	2,285	3,030	3,775	4,520	5,275	5,300
Land Lease	0	0	0	0	0	0
Building Repairs and Maintenance	36	36	36	36	36	36
Land, Water, Dyking Taxes	148	148	148	148	148	148
Legal and Accounting	100	100	100	100	100	100
General Insurance	200	200	200	200	200	200
Crop and Income Insurance	0	0	0	0	0	0
Utilities	20	20	20	20	20	20
Miscellaneous	120	120	120	120	120	120
Operating Interest	454	557	666	771	883	892
Term Loan Interest	1,652	1,602	1,546	1,484	1,413	1,334
TOTAL EXPENSES	13,042	15,634	18,365	20,970	23,721	23,801
EXCESS INCOME OVER EXPENSES	-82	1,646	3,235	4,950	6,579	6,499
Less Depreciation						
Plants and Hedging Plants	223	223	223	223	223	223
Buildings and Improvements	220	220	220	220	220	220
Equipment	983	983	983	983	983	983
NET FARM INCOME	-1,507	221	1,810	3,525	5,154	5,074

* For Income Tax purposes the cost of new root stock is added to the land cost base and neither claimed as an expense nor capital cost allowance.
* Prepare a cashflow budget that includes the cost of plants, operating interest, term loan payments, living expenses, capital purchases, and income tax.

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